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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Preparing Activity: KSC

NASA/KSC-27 13 13.00 98 (October 2007)

Superseding
NASA/KSC-27 13 13.00 98 (February 2007)

NASA/KSC GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2009

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DIVISION 27 - COMMUNICATIONS

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COMMUNICATIONS COPPER BACKBONE CABLING

10/07

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SECTION 27 13 13.00 98

COMMUNICATIONS COPPER BACKBONE CABLING
10/07

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NOTE: This specification covers the requirements for the copper cabling system for the outside cable plant. Accordingly, tailor this section carefully to suit project conditions and to meet project requirements.

Use of electronic communication is encouraged.

Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet. a Criteria Change Request (CCR).
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PART 1 GENERAL

1.1 REFERENCES

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NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a RID outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the

Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

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The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

JOHN F. KENNEDY SPACE CENTER (KSC)

KSC-STD-E-0009	(Rev B; 1993) Standard for Cable Numbering, Outside Plant Communication System

U.S. DEPARTMENT OF AGRICULTURE (USDA)

REA PE-74	(1985) Specification for Filled Splice Enclosures

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

7 CFR 1755.403	Copper Cable Telecommunications Plant Measurements
7 CFR 1755.890	RUS Specification for Filled Telephone Cables with Expanded Insulation

1.2 SCOPE

This section covers the requirements for audio pair telephone cables to be installed as indicated on contract drawings. Building locations for each task are indicated on contract drawings.

1.3 SUBMITTALS

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NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Keep submittals to the minimum required for adequate quality control.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, use a code of up to three characters within the submittal tags following the "G"

designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.

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Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that reviews the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Cable
Splice Connectors
Splice Cases
MDF
Connector Blocks
Protection Modules
Switch-through Modules
Terminal Blocks
Terminal Cabinets

SD-09 Manufacturer's Field Reports

Provide a preliminary test plan at least 30 days prior to testing.

End-to-End Tests
Continuity and Loop Resistance Tests
Insulation Resistance Tests
Cable Attenuation Tests

1.4 AUDIO CABLE IDENTIFICATION

Number audio cable identification per KSC-STD-E-0009 (Cable Numbering, Outside Cable Plant Communications System, Standard for)

The first two lines on the ID symbol must employ the following five characters:

First & Second Characters: Must denote the number of hundred groups of audio pairs in the cable.

Third Character: Must be a dash.

Fourth & Fifth Characters: Must denote the gauge of the audio wire.

The second line of the cable ID symbol indicates the conductors are audio type cable, number, and pair count.

Example: 06-22 Identifies a 600 pair, 22 gauge audio telephone cable No. 12, with pair count 1401-2000.
CA12:1401-2000

PART 2 PRODUCTS

2.1 CABLE

The cable must be manufactured as Audio Telephone Cable in accordance with the requirements of 7 CFR 1755.890. Supply all cable necessary to complete the job.

2.2 SPLICE CONNECTORS

Splicing must be accomplished utilizing Picabond individual, AMP No. 61292-2, or strip assembly, AMP No. 229917-2 or approved equal. Multiple conductor splice connectors must not be used.

2.3 SPLICE CASES

Underground splice cases must be suitable to house a straight, butt, or branch splice in a protective housing into which can be poured an encapsulating compound. The splice case must be of suitable thermoplastic, thermoset, or stainless steel material with structural members as part of the mold (i.e., ribs or waffle structure). The splice cases must be filled with an encapsulating compound which must be re-enterable and must not alter the chemical stability of the closure. Dry encapsulant must not be used. Filled splice cases must comply with REA PE-74. Quantities are indicated on drawings. AMP (or equal as approved by the Government) is a supplier of approved splice cases.

2.4 MAIN DISTRIBUTION FRAME (MDF)

The MDF to be installed in the CXT as shown on drawings, must be single sided and must be stand-alone. The frame must have universal connector mounting bars suspended off each vertical, with a series of jumper rings in between. The frames must include guard rails, end bars, and a copper ground bar across the base. The frame verticals must be on 8" centers.

The frame must be a welded construction of cold rolled angle, channel and bar steel, phosphatized and bonderized for corrosion and oxidation resistance. The finished frame must have multiple coats of "telephone gray" baked on enamel as the final protective finish.

2.5 CONNECTOR BLOCKS

Connector blocks must be Reliable Electric's Part No. R399A A40D or NT Cook Electric Part No. C-3886024OD or AT&T 310A2/310B2 or approved equal. Provide all new connector blocks fully equipped with protection modules switch through modules as described below.

2.6 PROTECTION MODULES

Protection modules must be of the three-electrode, five male pin, heavy duty gas tube type or solid-state equivalent type and must be REA and UL listed. Protection modules must have both voltage overload and sneak

current protection.

2.7 SWITCH-THROUGH MODULES

Use switch-through modules at the CXT locations to open/close the circuits at the connector blocks on the CXT frame. They must fit within the connector blocks in the same manner as do the protection modules. The number of switch-through modules provided must be as shown on the drawings.

2.8 TERMINAL BLOCKS

Terminal blocks must be 8 x 26 wire wrap/wire wrap line terminal blocks. Provide the terminal blocks at the CXT distribution frame only, in quantities shown in drawings.

2.9 TERMINAL CABINETS

Terminal cabinets to be mounted on walls or plywood backboards, must be 610mm x 610mm x 914mm 24" x 24" x 8" D or 914mm x 914mm x 203mm 36" x 36" x 8" D as required by the drawings, and must be equipped with a 19mm 3/4" plywood backboard. This backboard must be painted with flame retardant, prior to installation into the box. Protected entrance terminals must be installed to terminate the required number of copper pairs. These terminals must be 3M No. 4488 type or approved equal.

PART 3 EXECUTION

3.1 GENERAL

Ensure that all Contractors and subcontractors performing on-site work provide personnel who have experience and knowledge required to perform the various tasks for installation of the Audio Cable System.

Ensure that installers and fabrication personnel are familiar with the requirements of the technical specifications and other pertinent referenced documents of the contract.

Ensure that quality control personnel who inspect cabling and wiring installations and assembly work are appropriately qualified in the assigned work.

Ensure that communication cable splices and terminations are made by journeyman cable splicers who have experience performing the same such duties.

Ensure that cable testing personnel are experienced and appropriately qualified.

The qualifications for all management personnel responsible for the following work areas must be verified by personnel resumes furnished by the Contractor, prior to construction.

Audio Telephone Cable Installation
Audio Telephone Cable Splicing
Audio Telephone Cable Testing
Quality Control
Project Manager/Lead

The qualifications for all personnel who perform the work defined above

must be verified by personnel resumes, furnished by the Contractor at least thirty (30) days prior to any work initiation.

Each individual who is to perform cable splicing is required to perform a minimum of one acceptable sample splice and termination. Sample splices must not be incorporated in the job.

3.2 WORK IN MANHOLES AND CABLE VAULTS

The Contractor is responsible for ensuring that safe operating procedures are followed, work equipment is adequate, and personnel have received proper training. All atmospheric tests must be conducted by others prior to Contractor personnel entering a manhole or vault. Safety equipment must be inspected and approved by an authorized representative of the Contracting Officer.

Smoking is not permitted in or around open manholes. Protect open manholes by fences, railings, signs, flags, or lights, as applicable. Body static electricity that has accumulated must be discharged to ground prior to personnel contact with manhole covers. Removal of manhole covers must be performed by two men using hooks and employing proper lifting techniques. All manhole covers in the immediate vicinity of the duct system where work is to be performed must be removed to permit adequate ventilation.

A burn permit authorizing the use of torches, furnaces, and other open flame, heat-generating devices must be obtained prior to use of such devices (use is not permitted in manholes).

Each time work is begun, remove or pump excessive water from the manhole vault or duct run as required, prior to personnel entrance.

A manhole entry permit must be required for every manhole entry. This permit must be issued by NASA or one of its Contractors.

Perform vapor tests to ensure that the presence of explosive gases is below dangerous concentration levels (less than 0.25 percent by volume).

Perform above environmental tests each time work is started or at the initial crew change and repeat in a time interval not to exceed 8 hours. If prolonged forced ventilation is required, the time interval for additional tests must not exceed 2 hours.

Two persons must be present during manhole operations; one man enters the manhole, the other must remain outside. The outside man must be equipped with a communication device to call for help if necessary.

Operate blowers continuously while work is performed and until work is completed.

Blowers must not be placed in the manhole or cable vault, but must be located on the surface at a distance not less than 5 feet from the open manhole or cable vault to assure a safe operating atmosphere. Engine driven equipment must be located downwind from manholes and must have ducted exhausts away from manhole opening.

Use ladders of the proper length and type (wood or fiberglass) for entry into manholes.

3.3 UNDERGROUND CONDUIT

The duct or conduit assignment for individual cables must be as indicated and field verified. Cables must not be placed in ducts or conduits other than those indicated without Government approval.

All ducts to be used must be rodded, cleaned, and tested for alignment as specified in AFTO 3W3-10-12. Mechanical equipment with winch lines must be used at both ends of the section to be rodded, and allow the line to be worked back and forth through the ducts. The KSC duct system does not contain pulling lines and could contain orangeburg material. Some sections could require mechanical rodding equipment with cutting tools and water pressure equipment to clean and align the defective or blocked orangeburg duct as necessary.

3.4 CABLE PLACEMENT

Exercise adequate care when handling and storing reels of cable to prevent damage to the cable. Do not install cable with dents, flat spots, or other sheath distortions.

3.4.1 Securing Cable

Immediately after cable placement, temporary tags with the cable number and pair count must be attached to each end of each cable section.

Cables and equipment must be supported and secured as indicated. Where the specific method of support is not shown, use adequate supports and fasteners to secure cables and equipment in position. Provide non metallic supports and fasteners in manholes and vaults. Secure all cables and equipment installed in exterior locations so that they can not be dislodged or damaged by winds up to 125 miles per hour.

House cable splices in a splice case installed along the cable route, mounted in the duct system cable vaults and manholes. The splice case must provide a protected environment for the splices and must maintain the moisture barrier properties of the cable. Cable splices in duct or conduit sections are prohibited.

3.4.2 Bending

Use caution when bending cable to avoid kinks or other damage to the sheath. The bend radius must be as large as possible, with a minimum of not less than 10 times the outer diameter (O.D.) of the cable. Minimum radii must be increased when necessary to meet cable manufacturer's recommendations. Bending operations in manholes and vaults must be performed in accordance with the procedures and instructions of the manufacturer. Use cable bending shoes at duct or conduit ends when bending cable exiting a duct or conduit. The bending shoes must remain in place until racking, splicing, and tying is completed. Cables must not rest against the edge of the duct or conduit mouth.

3.4.3 Pulling

When a duct or conduit has an appreciable curve, and conditions permit, set up the cable reel at the end nearest the bend and pull the cable from the opposite end. Otherwise, pull the cable from the most convenient end.

Attach pulling lines to cable ends fitted with factory-installed pulling

eyes. Cables not equipped with a pulling eye must have the pulling line attached to the cable end by means of a cable grip. Do not use core hitches.

Set up at the pulling end so that the pulling line and cable enter or exit on a line parallel with the duct or conduit to prevent either from rubbing against the edge or mouth. Cable ends must not be pulled around sheave wheels. When the end slack for proper racking and splicing can not be obtained with the pulling line still attached to the end of the cable, a split cable grip can be used to obtain the necessary slack.

3.4.4 Set-Up

Locate and align cable reels so that the cable is paid off the top of the reel into the duct or conduit in a long, smooth bend, without twisting. Cable must not be pulled from the bottom of a reel or subjected to reverse bends from those formed by factory reeling. Use a cable feeder guide of proper size at the mouth entrance. Lay unterminated cables in the specified routing and location as indicated.

Clear, cap and seal cable ends. The lubricant must be compatible with,and intended for use with, Stalpeth sheathed cables. Soap and grease lubricants are prohibited.

Carefully check all equipment and the pulling set-up to minimize interruptions once pulling begins. Insofar as possible, pull the cable without stopping until the required amount of cable has been placed. If for any reason the pulling operation must be halted before the pull is complete, the tension of the pulling line must not be released. When pulling is resumed, the inertia of the cable must be overcome by increasing the tension in small steps a few seconds apart until the cable is in motion. The cable must be paid off the reel by rotating the reel in the feed direction and not stripped off the reel by pulling.

3.4.5 Damage

Carefully inspect the cable for sheath defects or other irregularities as it is paid off the reel. If defects are detected, pulling must stop immediately and the cable section must be repaired or replaced at the discretion of the Contracting Officer. A system of communications, visual or otherwise, must be maintained between feed and pulling locations so that pulling can be stopped instantly, if necessary. "Pull-thrus" (continuous cable through two or more duct sections without splicing in an intermediate manhole) require the approval of the Contracting Officer.

Use appropriate size split grip, manhole sheaves, sheave shackles, and increased lubricant, as well as exercising caution during the pulling operation, to avoid excess slack and prevent kinking or any damage to the cable. Cables in the intermediate manhole must be suitably racked at the time of installation, with no sheath defects or other irregularities.

Cable ends pulled into manholes or vaults that are not to be racked or otherwise permanently positioned, must immediately be tied in fixed positions with ties to prevent damage to the cables and to provide adequate working space. After final racking and splicing, plastic sheathed cables in manholes and vaults must be secured in place with lashed cable supports. When securing cables and details are not indicated, the cables must be secured in a manner that maintains the cables in the required position without damage to the cables.

3.5 CABLE SPLICING

Splice cables in accordance with the manufacturer's recommendation. Conductors must remain in their correct color sequence or groups as indicated.

Install undetermined cables as indicated. Unterminated or dead cable pairs must be connected through to other unterminated or dead cable pairs, cleared at each end and tested according to other portions of this specification.

For each copper splice point, after splice completion and prior to splice case installation and , the Government must inspect splice and approve workmanship.

3.6 BONDING AND GROUNDING SYSTEMS

Cable must be grounded as specified in Section 28 05 26.00 40 SECONDARY GROUNDING unless otherwise indicated. The overall shield of all cables installed must be grounded at each terminal point or bonded across all splice points and to a manhole bonding ribbon.

3.7 CABLE TERMINATIONS

Terminate cables as shown on contract drawings. Installation must not impede future installations and must not damage existing cables.

3.8 TESTING AUDIO CABLES

Test all cable pairs after installation. Electrical acceptance testing for cables under this specification must be in accordance with 7 CFR 1755.403. Field tests must be witnessed by the Government. Give five (5) working days notice prior to performing each test. The measured electrical parameter must conform to the manufacturer's stated specification. Sample forms included at the end of this section can be used. Include test forms and procedures in the test plan. Correct all test anomalies.

When splicing audio cable, test cable sections between splice cases, prior to filling splice cases with encapsulant as determined necessary. However, exercise care so that unfilled splice cases temporarily stored in manholes during testing are not subjected to ingress of water which can be found in manholes.

3.8.1 Test Equipment

Test equipment must be of sufficient accuracy, quality, and quantity to perform specified tests.

Perform insulation resistance tests with a 500-volt insulation resistance test set.

The use of auxiliary test boards, panels, or other special equipment to facilitate the testing procedure is optional, subject to approval. The equipment must not cause any appreciable change in the actual cable measurements being made and must be designed to permit ready verification of the internal circuits and components.

All test equipment must be calibrated by a certified testing company every

eighty (80) days, unless required sooner because of damage or inaccuracy. Standards for calibrating must be as listed by the National Bureau of Standards, and each item of test equipment must display a current calibration sticker.

3.8.2 Section Tests

Make end-to-end tests for pair identification, true pair, shorts, opens, grounds and splits and record each conductor condition separately. Conduct tests per 7 CFR 1755.403.

3.8.3 Continuity and Loop Resistance Tests

Make continuity and loop resistance tests of each pair and record. Conduct tests per 7 CFR 1755.403. Sample test forms are included at the end of this section.

3.8.4 Insulation Resistance Tests

Make and record end-to-end tests of each conductor to all other conductors and all conductors to ground (shield). Conduct tests per 7 CFR 1755.403. Sample test forms are included at the end of this section.

3.8.5 Cable Attenuation Tests

Test all outside plant cables for T1 type carriers for attenuation at a frequency of 772 Khz in accordance with 7 CFR 1755.403.

3.9 DATA SHEETS

SAMPLE DATA FORM, PARAGRAPH 3.8.2/3.8.3

CONTINUITY AND LOOP RESISTANCE TEST

CONTRACT
NAME/NUMBER:_____

CABLE NO.:_____ CABLE COUNT:_____ CABLE TYPE:_____

CABLE LOCATION: FROM:_____ TO:_____

CABLE LENGTH:_____ FT. GAUGE:_____

CONTINUITY: OUTER SHEATH:_____OHMs NO. SPLICES:_____

PAIR NUMBER	**	LOOP. RES. (OHMs)**	PAIR NUMBER	**	LOOP RES. (OHMs)**

** INDICATE SHORT, OPEN, CROSS, OR GROUND

TEST CONDUCTOR:_____ DATE:_____

CONTRACTING OFF. REP.:_____ DATE:_____

SAMPLE DATA FORM, PARAGRAPH 3.8.4

INSULATION RESISTANCE TEST

CONTRACT NAME/NUMBER:_____

CABLE NO.:_____ CABLE COUNT:_____ CABLE TYPE:_____

CABLE LOCATION: FROM:_____
TO:_____

CABLE LENGTH:_____ FT.
GAUGE:_____AWG

CONTINUITY: OUTER SHEATH:_____OHMs NO. SPLICES:_____

PAIR NUMBER	TIP OR RING	INS. RES. (MEGOHM)	PAIR NUMBER	TIP OR RING	INS. RES. (MEGOHM)
	Tip			Tip	
	Ring			Ring	
	Tip			Tip	
	Ring			Ring	
	Tip			Tip	
	Ring			Ring	
	Tip			Tip	
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	Tip			Tip	
	Ring			Ring	
	Tip			Tip	
	Ring			Ring	

TEST CONDUCTOR:_____ DATE:_____

CONTRACTING OFF. REP.:_____ DATE:_____

-- End of Section --